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September 25, 2014

VIA E-MAIL (BLACK.CHRISTOPER@EPA.GOV)
VIA U.S. MAIL

Christopher Black
Project Manager
U.S. EPA, Region 5
77 W. Jackson Blvd. LU-9J
Chicago, IL 60604

Re: Submittal of the Corrective Measures Proposal for the Ferro Corporation Facility located at 7050 Krick Road, Walton Hills, Ohio 44146 Docket Number RCRA-05-2011-0018

Dear Mr. Black:

Ferro Corporation (Ferro) is submitting a copy of the *Corrective Measures Proposal* for the Ferro Corporation Facility located at 7050 Krick Road, Walton Hills, Ohio.

If you have any questions regarding the document being submitted herein, please feel free to contact me at 216-875-5781.

Sincerely,

Kelly Wolfe

Kelly Wolfe,
Corporate Manager, EHS
Ferro Corporation

cc: John Evans, Ferro Corporation
Jason Perdion, Baker & Hostetler
Eric Wilburn, Hull & Associates, Inc.

CORRECTIVE MEASURES PROPOSAL

OF THE:
FERRO CORPORATION FACILITY
7050 KRICK ROAD
WALTON HILLS, OHIO 44146

Prepared for:
FERRO CORPORATION AND
BAKER & HOSTETLER LLP
1900 EAST 9TH STREET
CLEVELAND, OHIO 44114

Prepared by:
HULL & ASSOCIATES, INC.
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SEPTEMBER 2014

HULL

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1.0 INTRODUCTION

On September 30, 2011, the United States Environmental Protection Agency (U.S. EPA) Region 5 (U.S. EPA) and Ferro Corporation (Ferro) entered into an Administrative Order on Consent (Docket No. RCRA-05-20110-0018) (Consent Order) under Section 3008(h) of the Solid Waste Disposal Act, commonly referred to as RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 for the Ferro facility located at 7050 Krick Road, Walton Hills, Ohio (Site). The location of the Site is presented on Figure 1. Following the completion and submittal of the RCRA Environmental Indicators Report, the Consent Order requires that Ferro complete a Corrective Measures Proposal (CMP) for the facility in order to mitigate any potential existing and future unacceptable risks posed to human health and the environment at or from the Site.

A Site-Specific Risk Assessment (SSRA) was prepared and submitted to U.S. EPA within the *Summary and Assessment of Baseline and Delineation Investigation Activities* (Hull, 2013) report (Summary Report). The SSRA concluded that implementation of risk mitigation measures for the protection of construction/excavation workers was necessary. In addition, the SSRA presumptively assumed that land use at the Site would be restricted to commercial/industrial and that groundwater at the facility would not be utilized for potable purposes. Therefore, evaluation of corrective action measures for the Site is presented herein.

1.1 Purpose and Objective

The purpose of this CMP is to develop and evaluate potential corrective action alternatives for exposures to select environmental media at the Site based on findings from the baseline and delineation sampling activities described in the Summary Report. The objective of the CMP is to recommend a corrective action alternative that will achieve target clean-up standards and performance standards for selected environmental media at the Site.

1.2 Organization

This report follows the general organizational format presented in Chapter IV of the U.S. EPA publication RCRA Corrective Action Plan (Final) (U.S. EPA, 1994). This CMP includes:

- Section 1 – Introduction and purpose;
- Section 2 – Description of Current Conditions including background information;
- Section 3 – Corrective Action Objectives;
- Section 4 – Identification, Screening and Development of Corrective Measure Alternatives;

- Section 5 – Evaluation of Corrective Action Measure Alternatives;
- Section 6 – Recommendation of Corrective Action Measure;
- Section 7 – Public Involvement Plan; and
- Section 8 – Proposed Schedule.

2.0 SITE BACKGROUND

2.1 Site Description

Ferro owns and operates a polymer and additives manufacturing facility at the Site. As depicted on Figure 2, the Site is approximately 13.8 acres and contains numerous manufacturing and office buildings. The Site is located within an industrial area and is surrounded by other industrial facilities, including TJ Tool Works and Clarke's Family Trucking to the west, Hukill Chemical Corporation and the former Bedford Anodizing to the north, National Rolled Thread Die Co. to the east and TR Wigglesworth Machinery Co to the south. The southern facility boundary is Treat Road, while Krick Road makes up the eastern and a portion of the northern boundary of the facility. The Bedford Anodizing Facility makes up the remaining portion of the northern Site boundary.

The Site is currently used by Ferro for the manufacturing of polymer additives for a wide range of applications included adhesives, antimicrobials and wire and cable. Planned future use of the Site is reasonably anticipated to remain commercial/industrial land use.

2.2 Site History

Prior to Ferro acquiring the Site, the property was owned by Chase Dryer, a company who manufactured chemical paint drying additives. In the 1940s, Ferro acquired the majority of the property from Chase Dryer and began operations on December 15, 1944. By 1981, Ferro operations included manufacturing additives for the plastics and paint industries and included organo-metallic compounds used as thermal stabilizers for PVC plastics, organic and organo-metallic UV-light stabilizers for plastics, epoxidized vegetable oil plasticizers for plastics and organo-metallic paint driers. In 1990, operations at the Site consisted of:

- Non-hazardous oxidation of soybean oil with hydrogen peroxide
- Production of cadmium, barium, and zinc stabilizers for floor tile and linoleum
- Stabilizers for pliable plastics like vinyl seat covers and includes cadmium, barium, and zinc stabilizers.

In 1992, the operation of manufacturing additives for the paint and plastics industry was continuing. The operation now included the use of alkyl and aryl phosphates, metal salts and metal oxides and various other organo-metallic compounds. Presently, Ferro manufactures polymer additives for a wide range of applications including adhesives, antimicrobials and wire and cable.

2.3 Summary of Previous Investigations

The U.S. EPA completed a Preliminary Assessment/Visual Site Inspection (PA/VSI) for the facility on January 24, 1992, which included identification of ten Solid Waste Management Units (SWMUs) and no Areas of Concern (AOCs). A secondary U.S. EPA site visit on August 11, 2010 identified five additional SWMUs. Utilizing the PA/VSI and secondary U.S. EPA Site visit as a starting point, Hull completed a Current Conditions Report (CCR) for the Site that identified nine SWMUs and two AOCs, in addition to the SWMUs previously identified by the U.S. EPA. Based on information included in the U.S. EPA PA/VSI, the U.S. EPA secondary Site visit and the information obtained during the completion of the CCR, Hull determined that a total of seven SWMUs and two AOCs required further investigation. In order to determine the SWMUs and AOCs that required further investigation Hull utilized information contained within the U.S. EPA PA/VSI, historical data obtained during the completion of the CCR, as well as the Hull Site inspection to determine if the potential for a release of hazardous waste and/or hazardous constituents, which may pose an unacceptable risk to human health and the environment was likely to have occurred at each SWMU and AOC. Based on the aforementioned rationale, Hull determined that investigation at seven SWMUs and two AOCs was necessary. Through correspondence with the U.S. EPA it was determined that two additional SWMUs also required investigation. A summary of the CCR as well as the Summary Report are presented below.

2.3.1 Current Conditions Report

SWMUs and AOCs identified during the previous U.S. EPA inspections, from the Hull CCR and Addendum are summarized below. The history and current condition of each SWMU and AOC were evaluated and are summarized below. As presented on Figure 3, nine of these SWMUs and two AOCs were identified as requiring investigation.

SWMU 1: Drum Storage Pad

- Location: West of the powders manufacturing warehouse
- Dates of Operation: Unknown
- Unit Description: 40- by 80-foot concrete pad
- Functionality: Manages waste from various areas throughout the facility
- Status: Closed October 2001
- Current Condition: Used as a storage area for empty drums, concrete in good condition with no evidence of cracking or staining.

Historical Data: **Generator Closure Hazardous Waste Accumulation Area, The Kelly-Buck Company, October 2001**

In 2001, Ferro closed one hazardous waste accumulation area. The hazardous waste accumulation area was located in the northwest portion of the Site and was used for less than 90 day storage of hazardous waste. The area consisted of a 55- by 65-foot concrete pad with a 24- by 24-inch concrete inlet grate at the center of the accumulation area. The grate drains to the north in an 8-inch polyvinyl chloride outlet with a riser that serves as an oil separator device, prior to discharge to the municipal storm sewer. The area was thoroughly cleaned. A sample from the rinseate was collected and analyzed for volatile organic compounds (VOCs), formaldehyde, phenol, RCRA metals and RCRA characteristic waste parameters, and compared to Ohio EPA Closure Plan Review Guidance (CPRG) decontamination standards. All values for the parameters tested were below the Ohio EPA CPRG decontamination values and was therefore considered a properly decontaminated area.

- **Further Assessment Required: No**

SWMU 2: Satellite Accumulation Areas

SWMU #2A – Outside High Pressure Building

- Location: Outside, west of High Pressure Building
- Dates of Operation: Unknown – mid-1990s
- Unit Description: 55-gallon steel drums on concrete floor
- Functionality: Manages waste from operations in a section of the plant
- Status: Inactive
- Current Condition: Removed in late 1990s, stored chromium and copper, concrete pad with no evidence of staining or cracking
- Historical Data: None
- **Further Assessment Required: No**

SWMU #2B – Liquids Manufacturing Building

- Location: Inside liquids manufacturing building
- Dates of Operation: Unknown – Present
- Unit Description: 4 drums of hazardous waste inside liquids manufacturing (one used oil), Liquids manufacturing staging area - two white drums on pallet, concrete flooring, solid waste only;
- Functionality: Manages waste from operations in the liquids manufacturing building
- Status: Active

- Current Condition: Multiple 55-gallon steel waste drums on a concrete floor, trenches drain to Biotreatment Plant, no evidence of staining or cracking
- Historical Data: None
- **Further Assessment Required: No**

SWMU #2C – Powders Manufacturing Building

- Location: Inside powders manufacturing building
- Dates of Operations: Unknown
- Unit Description: 55-gallon waste drums on concrete floor
- Functionality: Manage waste from powders manufacturing operation
- Status: Closed
- Current Condition: No drums, concrete floor with no significant staining and cracking
- Historical Data: None
- **Further Assessment Required: No**

SWMU 3: R & D Container Storage Area

- Location: South of the R & D building (Analytical building # 22)
- Dates of Operation: Unknown
- Unit Description: Several 55-gallon steel drums on wooden pallets
- Functionality: Waste staging area for waste generated in R & D building
- Status: Closed
- Current Condition: Large outdoor elevated concrete pad, significant cracking, minor surface staining
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 4: Drum Storage Area in the Boiler Room

- Location: Boiler room located in the center of the Site
- Dates of Operation: Unknown
- Unit Description: NA
- Functionality: NA
- Status: Never Operated
- Current Condition: According to Ferro, no drums were ever stored inside the boiler room. All drum storage around the boiler room was located outside on area to the west of boiler room. No drums observed during reconnaissance

- Historical Data: None
- **Further Assessment Required: No**

SWMU 5: Cadmium Dust Collection Unit

- Location: East of the raw materials warehouse
- Dates of Operation: 1976 - Present
- Unit Description: 15-foot high cadmium dust collector
- Functionality: Collection of cadmium dust produced during manufacturing process
- Status: Active
- Current Condition: According to Ferro, cadmium was never used in dust collector. It was in the product code but not stored as waste. Barium and zinc were the only constituents in the dust. No cracking or stains were noted on the concrete pad.
- Historical Data: None
- **Further Assessment Required: No**

SWMU 6: Waste Oil Storage Area

- Location: East of the raw materials warehouse
- Dates of Operation: Unknown
- Unit Description: 40- by 40-foot outdoor storage area of several 55-gallon drums on wooden pallets on a concrete or gravel surface
- Functionality: Store used oil from engine oil changes, wastewater treatment operations and other maintenance operations
- Status: Closed
- Current Condition: No drums located outside of oil shed. Rust-stain rings from previously stored drums were noted. All waste oil stored inside shed with concrete floor with no signs of cracks. No signs of cracks or staining noted on outdoor concrete pad of previous drum storage.
- Historical Data: None
- **Further Assessment Required: No**

SWMU 7: Epoxy Wastewater Pretreatment Facility

- Location: West of epoxy plant
- Dates of Operation: 1972 - 1993
- Unit Description: Two holding tanks, a lime silo and a neutralization tank were contained in a 80- by 40-foot bermed concrete area
- Functionality: Pre-treat wastewater from epoxy manufacturing area

- Status: Closed
- Current Condition: No longer in operation. Water has always been pumped to sanitary sewer line located north of the bermed area. According to Ferro - no water was ever pumped through oil/water separator in parking lot area.
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 8: Wastewater Treatment Facility

- Capacity: 10,000 gallons per day
- Location: South of the fine organics building
- Dates of Operation: 1974 - Present
- Unit Description: Acidification tank, API oil separator, lime precipitation mix tank, pressure filter and sludge drop box
- Functionality: Equalize, break emulsions, separate oil, neutralize, chemically precipitate, separate solids and liquids and dewater sludge from materials generated on-Site
- Status: Active
- Current Condition: Currently operating - all trenches go to Biotreatment plant before discharging to sanitary sewer system.
- Historical Data: None
- **Further Assessment Required: No**

SWMU 9: Sludge Bin Roll Away Container

- Location: East of fine organics building
- Dates of Operation: 1986 - 1993
- Unit Description: 20-cubic yard steel roll-away container
- Functionality: Manage solid waste from SWMU #8
- Status: Closed
- Current Condition: Located on concrete pad with no signs of staining or cracking. Drain located on northern section of pad.
- Historical Data: None
- **Further Assessment Required: No**

SWMU 10: Polyamine Construction Area (determined to be the same as SWMU 11)

- Location: See SWMU #11
- Dates of Operation: See SWMU #11

- Unit Description: See SWMU #11
- Status: See SWMU #11
- Current Condition: See SWMU #11
- Historical Data: See SWMU #11
- Further Assessment Required: See SWMU #11

SWMU 11: Buried Drum Removal Area

- Location: Southwestern side of Site
- Dates of Operation: 1970 - 1990
- Unit Description: Former trenches used to bury drums
- Status: Inactive as of August 25, 1990
- Current Condition: Polyamine Building located over this area, no evidence of former drum trenches
- Historical Data:

Drum Clean-up, McLaren/Hart Environmental Engineering Corporation, 1990

During the construction of the Polyamine Building, approximately 15 buried drums were discovered. A geophysical investigation was performed to determine the location and extent of the buried drums. During excavation, 14 partially full drums with lead-containing solids, one partially filled solvent-containing liquid drum and numerous crushed and empty drums, laboratory bottles, and several pressurized gas cylinders were discovered. Approximately 500 to 600 cubic yards of soil was also removed to ensure clean-up of all the potentially contaminated soil. The final excavation trench was 75-feet long, 12 to 20-feet wide, and 6 to 14-feet deep. Additional background soil and clearance soil samples were collected from the floor and walls of the trench. These samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), RCRA metals and nickel. None of the background or clearance samples exceeded the U.S. EPA Toxicity Characteristic Leaching Procedure (TCLP) limits.

The data indicate that both the background and clearance samples may exceed current risk-based industrial screening levels for both arsenic and chromium. Two of the clearance samples would also exceed the industrial risk-based screening level for lead.

- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 12: North Tank Farm

- Location: North of fine organics building along northern Site boundary
- Dates of Operation: 1972 - 1993
- Unit Description: 14 regulated USTs – 13 abandoned in place, one wastewater tank in operation (as of 1993)
- Functionality: Store wastewater, petroleum products, regulated substances and non-regulated wastewater
- Status: Closed March 26,1993; NFA
- Current Condition: Area covered with gravel
- Historical Data:

Closure/Site Assessment Report of the Fine Organics North Tank Farm, WW Engineering & Science, June 1993

The report details the in-place closure of 11 of the 14 USTs in the North Tank Farm. During the closure, a small hole was noted in tank T-21. T-21 was an 8,000-gallon partitioned tank that contained two separate 4,000-gallon sections. The leak was discovered in the 4,000 gallon xylene-containing side of T-21. It was determined that the release was confined to the tank farm cavity. Additional Site assessment involved installing eight soil borings, six outside the UST cavity and two inside the UST cavity. The two soil borings inside the tank cavity were converted to monitoring wells. No groundwater was encountered during the drilling of any of the soil borings. Only one of the soil samples directly adjacent to the tank cavity showed benzene, toluene, and xylene levels exceeding Bureau of Underground Storage Tank Regulations (BUSTR) Category 3 Action Levels. The Category 3 Action Levels were the 1992 BUSTR standards and were determined by the distance of the UST to the closest potable-water supply, average depth to groundwater, predominant soil type, etc. One of the wells had benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations above the Category 3 Action Levels. Based on this information it was concluded that soil and water contamination were restricted to the tank cavity and a Remedial Action Plan was developed to bioremediate the tank cavity.

Final Risk-based Corrective Action (RBCA) Tier I Site Assessment North Tank Farm, August Mack, February 12, 2001

The report indicates that in December 1993, BUSTR approved an in situ bio-remediation plan for the North Tank Farm. The remediation scheme involved spraying a nutrient peroxide and water solution onto the ground, which was installed and tested by Earth Tech in 1994. The system was operational for nine month intervals from Spring to Fall 1995 and Spring to Fall 1996. It was determined that the remediation scheme was not achieving the desired results due to a low infiltration rate and insufficient supply of oxygen and nutrients.

In August 1999, August Mack collected soil samples from the North Tank Farm. It was later determined that the soil inside the tank farm was saturated, which makes the samples inappropriate for soil analysis. Soil samples from the North Tank Farm were recollected in August and September 2000. Nine soil borings were installed throughout the North Tank Farm to depths of 3 to 16 feet. The selected soil samples were analyzed for VOCs, polynuclear aromatic hydrocarbons (PAHs), iron, pH, nitrite, nitrate and ammonia. Two previously installed monitoring wells were used to sample the water within the tank cavity. Water samples were analyzed for VOCs, PAHs, dissolved iron, pH, nitrite, nitrate, ammonia and phenolics. Four of the seven soil samples contained detectable concentrations of toluene, ethylbenzene and total xylene. All water samples had detectable concentrations of multiple VOCs, with the highest concentrations being acetone (1.91 mg/L), ethylbenzene (18.9 mg/L), toluene (4.57 mg/L) and total xylenes (76 mg/L) in PW-1.

UST Closure Plan for the North Tank Farm, Hull & Associates, Inc., July 2001

On June 25 and 29, 2001, Hull installed six additional direct-push soil borings at the south end of T-21 and T-20. Soil samples were analyzed for total petroleum hydrocarbons (TPH), VOCs, and SVOCs. Soil samples indicated ethylbenzene exceeded U.S. EPA RBSLs (Risk-based Screening Levels) in multiple borings. These results prompted a Tier II investigation at the Site.

Risk-based Corrective Action (RCBA) Tier II Evaluation/ Site-Specific Risk Assessment, Hull & Associates, Inc., December 2001

A risk-based corrective action Tier II was performed at the North Tank Farm in response to chemicals of concern (COCs) exceeding RBSLs during the Tier I evaluation. The Tier I evaluation revealed ethylbenzene concentrations that exceeded the U.S. EPA RBSL and additional COCs that do not have a RSBL and; therefore, require additional testing. Hull completed an exposure assessment to determine the magnitude, frequency, duration and type of potential exposure to the COCs found in the North Tank Farm. A toxicity assessment was also performed to evaluate the toxicity of the identified COCs and to estimate the dose-response relationship for each of the chemicals. It was concluded that a current commercial/industrial worker would likely not face adverse health effects while performing outdoor work in the area of the North Tank Farm. This was also concluded to be the case for a future commercial/industrial worker and an excavation/construction worker. Hull concluded that there would likely not be carcinogenic effects to the aforementioned groups.

U.S. EPA, Letter for No Further Action

After the December 2001 Hull report, the U.S. EPA issued a letter of no further action for the in-place closure of all fourteen tanks in the North Tank Farm.

- **Further Assessment Required: No**

SWMU 13: West Tank Farm

- Location: West of Fine Organics Building
- Dates of Operation: 1983 - 1995
- Unit Description: Seven USTs
- Functionality: Store various petroleum products, hazardous substances and non-regulated substances
- Status: All tanks removed in 1995; NFA – April 14, 2005
- Current Condition: All tanks removed, area currently gravel lot, four white PVC ventilation pipes remain visible above ground
- Historical Data:

West Tank Farm Closure Report, Earth Tech, November 1995

Closure activities at the West Tank Farm involved the removal of seven underground storage tanks (USTs). Five of the USTs were located in the same cavity, while the remaining two were located in an additional cavity. All of the USTs were in good condition and showed no signs of holes or potential leakage at the time they were removed. Thirteen soil samples from the UST cavities were taken and analyzed for BTEX, TPH and polynuclear aromatics (PNAs). The samples revealed that the stockpile used to backfill the larger tank vault exceeded the BUSTR Category 4 Action Levels for ethylbenzene and total xylenes. No additional exceedances were noted. It is possible the exceedance was from an on-Site release of Therminal 59 (heat transfer fluid). Bio-venting pipes were installed into the impacted soil to provide oxygen to naturally occurring microbes to assist in the degradation of the residual hydrocarbons.

Final Risk-based Corrective Action (RBCA) Tier 1 Site Assessment West Tank Farm, August Mack, February 12, 2001

In August 1999, August Mack installed 6 soil borings throughout the former West Tank Farm. Samples were collected and analyzed for VOCs, PAHs, iron, pH, nitrite, nitrate and ammonia. In addition to the 6 soil borings, a water sample was collected from the cavity of the West Tank Farm. According to the report, the bio-venting system was never operated, however, the bio-venting pipes that were previously installed were still in place and used to gauge and collect a water sample from the tank farm cavity. The water sample was analyzed for VOCs, PAHs, dissolved iron, pH, nitrite, nitrate, ammonia and phenolics. Four of the nine soil samples analyzed contained detectable concentrations of toluene, ethylbenzene and total xylene. The highest value recorded was 0.0175 mg/kg for any of the compounds tested. The water sample did not have

any detection above laboratory limits for any of the constituents analyzed. A Tier 1 Site classification was also performed. Results indicated that the Site is a Classification 4 Site and there are no demonstrable long-term threats.

Request for No Further Action for the West Tank Farm, Hull & Associates, Inc., July 2001

Citing the information in the July 1999 Tier 1 Evaluation performed by August Mack, Hull prepared a letter to the U.S. EPA requesting no further action for the West Tank Farm.

U.S. EPA, Letter for No Further Action, April 14, 2005

The U.S. EPA approved the request for no further action for the 1995 removal and closure of seven USTs in the West Tank Farm on April 14, 2005.

- **Further Assessment Required: No**

SWMU 14: In-fill Area (Lower Parking Lot)

- Location: West of Epoxidation Plant
- Dates of Operation: Filled in the early to mid-1990s
- Unit Description: Gravely parking area with 10,000-gallon oil/water separator, had areas of staining prior to being covered with blue clay
- Status: 10,000-gallon interceptor in operation
- Current Condition: Gravel parking area
- Historical Data:

Ferro Corporation Yearly Sampling Events, 2006-2009

Ferro provided Hull copies of yearly sampling reports from water samples collected at two outfalls. The first outfall was identified as the Street Interceptor where off-site storm water commingles with the water effluent from the oil/water separator prior to discharging off-Site. The second outfall is located where the culvert containing the on-Site tributary daylights at the northwest corner of the Site. The table below summarizes the maximum contaminant concentration recorded, as well as the most recent sampling data.

	Human Health Standard (non drinking)	Aquatic Life OMZA Standard	Maximum Concentration	Year	Location	2009 Maximum Concentration
Metals	**µg/L**	**µg/L**	**µg/L**			**µg/L**
Barium	160,000	220	119	2006	Outfall	98.4
Cadmium	730	2.5	**16**	2007	Street Interceptor	BDL
Chromium	14,000	86	10	2006	Street Interceptor	BDL
Copper	64,000	9.3	**43**	2006	Street Interceptor	BDL
Iron			2220	2006	Street Interceptor	BDL
Lead		6.4	**14**	2006	Street Interceptor	BDL
Nickel	43000	52	15	2006	Street Interceptor	BDL
Zinc	35000	120	102	2007/2009	Street Interceptor/Outfall	102
VOCs						
cis-1,2-Dichlorethene		970	46.8	2009	Outfall	46.8
Ethylbenzene	8900	61	9.16	2006	Outfall	BDL
Vinyl chloride	28	930	8.52	2009	Outfall	8.52
Xylene	83000	27	**59.2**	2006	Outfall	BDL
SVOCs						
Bis(2-Ethylhexylphthalate	32	8.4	**10.3**	2007	Street Interceptor	BDL

- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 15: Site Wide Groundwater

- Location: Throughout Site
- Dates of Operation: NA
- Unit Description: NA
- Current Condition: Unknown
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 16: Fine Organics 90 Day Storage

- Location: Under T-9 in FO
- Dates of Operation: Unknown - 2005
- Unit Description: 1-cubic yard tote box
- Functionality: Store flammable wastes

- Status: Inactive
- Current Condition: Current waste soybean oil process waste only, concrete floor, no cracking, floor drains discharge directly to Biotreatment plant
- Historical Data: None
- **Further Assessment Required: No**

SWMU 17: 90 Day Bulk Storage

- Location: T101
- Dates of Operation: 1985 - Present
- Unit Description: 10,000-gallon stainless steel tank
- Functionality: Store bulk liquid waste from LWTP, Liquids & Pilot Plants
- Status: Active
- Current Condition: AST - concrete pad with secondary containment
- Historical Data: None
- **Further Assessment Required: No**

SWMU 18: Trash Compactor

- Location: South Analytical
- Dates of Operation: Unknown
- Unit Description: Closed box on concrete pad
- Functionality: Compact general, non-hazardous trash
- Status: Active
- Current Condition: Concrete pad, no evidence of cracking, all non-hazardous wastes
- Historical Data: None
- **Further Assessment Required: No**

SWMU 19: Epoxy Press Cake Hopper

- Location: Epoxy Building
- Dates of Operation: Unknown - Present
- Unit Description: Open top container
- Status: Active
- Current Condition: Stored on concrete pad, covered with tarp when not adding material
- Historical Data: None
- **Further Assessment Required: No**

SWMU 20: Biotreatment Plant

- Location: West end of Site
- Dates of Operation: 1993 - Present
- Unit Description: Multiple tanks
- Functionality: Treat wastewater from plant operations
- Status: Active
- Current Condition: Secondary containment, concrete, three weeks in digester then discharged to the Northeast Ohio Regional Sewer District (NEORSD) Southerly plant, two tanks at western edge of plant contain untreated plant process water
- Historical Data: Bi-annual sampling of water discharged to NEORSD
- **Further Assessment Required: No**

SWMU 21: Former Northern Hazardous Waste Storage

- Location: North of Fine Organics
- Dates of Operation: Unknown
- Unit Description: 55-gallon solvent waste drums and a solvent waste tank
- Status: Closed
- Current Condition: Currently new tank farm all with secondary containment, all concrete with no signs of cracking or staining
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 22: Underground Acid and Waste Tanks

- Location: East of the Raw Materials near the Powders building
- Dates of Operation: Unknown
- Unit Description: Four USTs in a concrete vault
- Status: Closed
- Current Condition: Four tanks in concrete vault. Three tanks contained raw materials storage (mineral spirits and solvents), one tank contained process water. Tanks closed in place and filled with sand in early 1980s. Waste process water collected from plant and pumped to pre-treatment area, contained cadmium and zinc
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

SWMU 23: Less Than 90 Day Hazardous Waste Storage Area

- Location: Powders Building
- Dates of Operation: Unknown - Present
- Unit Description: 55-gallon drums stored on concrete floor with secondary containment
- Status: Active
- Current Condition: concrete floor, secondary containment
- Historical Data: None
- **Further Assessment Required: No**

SWMU 24: Boiler Room Tank Farm

- Location: West of Boiler Room
- Dates of Operation: Unknown
- Unit Description: Two fuel oil USTs and one hazardous waste UST
- Status: Closed
- Current Condition: Concrete pad, no evidence of existing USTs.
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

AOC 1: Xylene Spill

- Location: West of Liquids Manufacturing Building
- Dates of Spill: March 13, 1998
- Unit Description: Numerous ASTs with various chemicals
- Status: Closed
- Current Condition: Tank farm no longer in operation, new tank farm moved closer to building
- Historical Data:

Project Documentation for Xylene Contaminated Soil Excavation and Disposal, Beta Environmental Management, Inc., Fall 1998

The report documents the removal and remediation of xylene contaminated soils associated with a spill of xylene outside the liquids building loading dock and in the vicinity of the old AST farm. A total of approximately 115 tons of contaminated soil was removed.

Project Documentation for Hazardous & Non-hazardous Soil Excavation and Disposal, Beta Environmental Management, Inc., Fall 1998

The report documents the removal and remediation of contaminated soils associated with the construction of the new AST farm outside of the liquids building loading dock. A total of approximately 710 tons of soil was removed. Soil samples collected during the excavation were collected and analyzed for TCLP. Two areas of soil were found to be hazardous, as they contained lead and cadmium concentrations that exceeded the regulatory limit for hazardous waste.

- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

AOC 2: Solvent USTs

- Location: East of Analytical Building
- Unit Description: Two solvent USTs
- Status: Unknown (removed between 1963 and 1966)
- Current Condition: Grassy area, no evidence of USTs
- Historical Data: None
- **Further Assessment Required: Yes**
- **Further Assessment Completed: Yes**

2.3.2 Summary and Assessment of Baseline and Delineation Sampling Investigation Activities Report

Based upon the information presented in the CCR, a Field Sampling and Analysis Plan (FSAP) was developed in May 2012 to detail proposed investigation at seven SWMUs and two AOCs. In response to U.S. EPA comments, an Addendum to the FSAP was submitted; the U.S. EPA approved the Addendum on September 27, 2012.

The Site assessment and investigation activities completed as part of the FSAP included the collection of soil samples, the installation and sampling of groundwater monitoring wells, the installation and sampling of vapor probes, and the collection of sediment and surface water samples within the unnamed tributary to Tinkers Creek. A comprehensive summary of analytical data collected as part of the sampling activities is included in the Summary Report.

Analytical data collected as part of the baseline and delineation sampling activities were evaluated within the Summary Report as part of a Site-Specific Risk Assessment (SSRA). Parameters detected in each

environmental media were subjected to a chemical of concern (COC) screening process for both human and ecological receptor populations. The COCs retained for further evaluation within each environmental medium were quantitatively or qualitatively assessed to determine whether unacceptable hazards or risks exist for identified receptor populations at the Site. For the purposes of this CMP, a brief summary of the results of the SSRA, organized by SWMU/AOC, are presented below. Please refer to the SSRA included within the Summary Report for a comprehensive evaluation of complete exposure pathways, receptor populations, calculation of hazards and risks, and qualitative assessments of environmental media likely impacted by off-Site sources.

SWMU 3: R&D Container Storage Area

The R&D container storage area, located south of the R&D Building was formerly used as a waste staging area for wastes generated in the R&D Building. Based upon the data collection and assessment activities completed for this SWMU, no unacceptable hazards and risks were identified for SWMU 3. No further evaluation of this SWMU is necessary.

SWMU 7: Epoxy Wastewater Pretreatment Facility

The Epoxy wastewater pretreatment facility was used to pre-treat water from the epoxy manufacturing area prior to discharge to the sanitary sewer. This facility is no longer in use. Based upon the data collection and assessment activities completed for SWMU 7, no unacceptable hazards and risks were identified for this SWMU. No further evaluation of SWMU 7 is necessary.

SWMU 11: Buried Drum Removal Area

The buried drum removal area was an area of trenches used to bury drums. The former buried drums have been excavated and the polyamine building is currently over top of the former buried drum removal area. Based on data obtained during the investigation activities and the corresponding SSRA for this SWMU, no unacceptable hazards and risks were identified for SWMU 11. No further evaluation of SWMU 11 is necessary.

SWMU 14: In-Fill Area (Lower Parking Lot)

<u>Soil</u>

The in-fill area is a gravel parking area with a 10,000-gallon oil/water separator that was filled in the early 1990s. This area includes an unnamed tributary to Tinkers Creek that was culverted as part of the filling activities in the early 1990s. The area is currently used for the storage of filled product trucks. Based upon the soil data obtained during the investigation activities and corresponding SSRA for this SWMU, no unacceptable hazards and risks were identified in soil for SWMU 14. No further evaluation of soil from this SWMU is necessary.

Surface Water

Surface water samples were collected from the unnamed tributary to Tinkers Creek in both the daylighted portion of the tributary and the culverted portion of the tributary. Based upon the information obtained during the investigation activities conducted on site, the fact that Ferro operations never utilized the chlorinated compounds detected, along with a review of documents for off-property sources (i.e., release from Bedford Anodizing's neighboring facility) which are the likely cause of the detected compounds, suggests that the elevated chlorinated compounds observed in surface water are not attributable to current or historic operations at the Site. As a result, further evaluation of detected analytes in surface water as a direct result of historical or current operations by Ferro that may be subject to regulatory action under RCRA is not necessary.

Sediment

Sediment samples were collected from the open part of the unnamed tributary to Tinkers Creek. Based upon the information obtained during the investigation activities coupled with potential impacts from off-property sources (i.e., Bedford Anodizing), Ferro believes that the elevated PAH compounds observed in sediment are not attributable to current or historic operations at the Site. As a result, further evaluation of detected analytes in sediment as a direct result of historical or current operations by Ferro that may be subject to regulatory action through RCRA is not necessary.

SWMU 15: Site Wide Groundwater

Groundwater was listed as a SWMU in the U.S. EPA 1992 PA/VSI and was investigated Site-wide during the baseline and delineation investigation activities discussed herein. Based upon the information obtained during the investigation activities, particularly the presence of elevated chlorinated compounds observed in groundwater from monitoring well HMW-3, coupled with the fact that Ferro operations never utilized the detected chlorinated compounds, (i.e., absence of an on-Site source for the chlorinated compounds), it was determined that the source of chlorinated compounds was not originating from any SWMU at the Site. However, when monitoring well HMW-3 is removed from the analytical dataset on the basis of depth to groundwater, no unacceptable hazards and risks are identified for the groundwater analytical dataset. Therefore, further evaluation of detected analytes in groundwater as a direct result of historical and current operations by Ferro that may be subject to regulatory action under RCRA is not necessary.

SWMU 21: Former Northern Hazardous Waste Storage

The former northern hazardous waste storage area was used to store 55-gallon solvent waste drums and a solvent waste tank that is no longer in use. Based upon the information obtained during the investigation activities and corresponding SSRA for this SWMU, no unacceptable hazards and risks were identified for SWMU 21. Further evaluation of SWMU 21 is not necessary.

SWMU 22: Underground Acid and Waste Tanks

Four tanks were located in a concrete vault, which contained raw material storage and process water. Based upon the information obtained during the investigation activities and corresponding SSRA for SWMU 22, no unacceptable hazards and risks were identified for this SWMU. No further evaluation of SWMU 22 is necessary.

SWMU 24: Boiler Room Tank Farm

Two fuel oil USTs and one hazardous waste UST were previously used in the area to the west of the boiler room. Based upon the information obtained during the investigation activities and corresponding SSRA for this SWMU, no unacceptable hazards and risks were identified for this SWMU. No further evaluation of SWMU 24 is necessary.

AOC 1: Xylene Spill

A spill of xylene was reported while filling ASTs, located to the west of the liquid manufacturing building. Based upon the data collection and assessment activities completed for AOC 1, no unacceptable hazards and risks were identified for this AOC. No further evaluation of AOC 1 is necessary.

AOC 2: Solvent USTs

Two solvent USTs were formerly located in a grassy area, east of the analytical building. Based upon the information obtained during the investigation activities and corresponding SSRA for this AOC, no unacceptable hazards and risks were identified for this AOC 2. No further evaluation of AOC 2 is necessary.

Site-Wide Evaluation

Direct contact hazards and risks posed to the on-Site Construction/Excavation Worker receptor population were estimated on a Site-wide basis, rather than by SWMU/AOC. The direct contact hazards and risk estimates quantified for the on-Site Construction/Excavation worker meet acceptable hazard and risk goals when each environmental medium is considered individually (i.e., total soil, groundwater and sediment). However, acceptable hazard and risk goals are not met when all direct contact exposure pathways are considered cumulatively, Therefore, a Risk Mitigation Plan (RMP) is necessary to protect on-Site Construction/Excavation Workers from potentially cumulative exposures at the Site.

2.4 Site-Specific Geology and Hydrogeology

2.4.1 Site-Specific Geology

Review of soil boring logs and monitoring wells completed at the Site indicates that the majority of the Site is covered by three distinct stratigraphic units. Unit #1 is fill material that ranges from 0 feet to 20 feet

with an average thickness of 12.0 feet (Urban Land). The fill material encountered typically consists of construction/demolition debris in a clayey to silty matrix located near the surface. In some instances this unit supports a thin vegetative layer. Unit #2 is a brown silty clay loam that ranges from 1.0 feet to 15.5 feet with an average thickness of 7.0 feet. The thickness of Unit #2 is highly dependent on the thickness of Unit #1. Unit #3 consists of gray weathered shale encountered at depths ranging from 12 to 25 feet bgs. Based on well logs at the Site, the bedrock surface appears to display a slight dip to the west along an east-west transect, but is approximately 10.0 feet shallower in the southern portion of the Site than the northern portion of the Site. The Ohio Division of Geological Survey (ODGS) Bedrock Topography of the Northfield, Ohio, Quadrangle map (1996) indicates that bedrock at the Site is fairly flat lying and displays a gentle slope to the northwest.

2.4.2 Site-Specific Hydrogeology

Groundwater was typically not encountered during drilling, but was encountered at depths ranging between 1.5 and 4.0 feet bgs during drilling in three of the thirteen monitoring wells. The areas of shallow groundwater were associated with small sand and gravel seams. Groundwater elevations rose up in their casings approximately 13.4 feet, on average. Some groundwater entered the set wells almost immediately, but the majority of the wells did not contain groundwater until approximately 24 hours after well installation. Groundwater elevations recorded following the well installations indicate that the major water bearing unit at the Site is located at the silty clay, shale interface and that the groundwater encountered exhibited characteristics of confined conditions.

Based on the groundwater surface elevations, groundwater beneath the Site flows predominantly to the northwest, with the exception of the western portion of the Site. Due to the influence of the unnamed tributary to Tinkers Creek groundwater flow in the western portion of the Site is both south onto the Site and north towards the former stream. In addition, it appears that groundwater is in communication with the unnamed tributary to Tinkers Creek. Groundwater gradients at the Site range between approximately 0.057 ft/ft (HMW-9 to HMW-10) and 0.015ft/ft (HMW-10 to HMW-3).

2.4.3 Groundwater Use

The City of Cleveland currently provides potable water to the Site. No evidence of use of groundwater as a potable water source was evident during this investigation. While groundwater is not used as a potable source at the Site, based on the location and size of twenty-six wells identified by ODNR, it is likely that they are private water supply wells. According to information provided by the Cuyahoga County Auditor, all but three of the well locations are connected to a municipal water supply. The three properties that are not connected to the municipal water supply and likely use their well as a source of potable water are installed to depths ranging between 100 and 178 feet bgs. Two of the wells are installed into the

sandstone unit that directly underlies the shale unit that was encountered at the Site. The sandstone unit was encountered 97 and 98 feet bgs. The third potable well that appears to be in use is installed into a shale aquifer, which was encountered 162 feet bgs and underlies that sandstone unit in which the other two wells are installed. The closest of these wells is located approximately 0.25 miles to the west of the Site. The other two wells are located approximately 0.37 and 0.41 miles to the southeast and east, respectively. Based on available information, the shallow groundwater at the silty clay, shale interface, encountered at the Site, is not used as a potable water source. Due to the thick and confining nature of the shale unit, contamination of lower aquifers from on-Site sources is unlikely.

2.5 Interim Corrective Measures

During August 2014, the U.S. EPA, Ferro, and Hull participated in a conference call to discuss any concerns or questions that U.S. EPA may have related to the Summary Report. During the call, Ferro indicated that implementation of an RMP for the protection of on-Site construction/excavation workers would be proposed within the CMP and developed as part of implementation of the CMP. A hardcopy of the RMP recently developed for the Site is being submitted concurrently with this CMP under separate cover. The RMP includes risk mitigation measures for potential cumulative direct contact exposures by construction/excavation workers to soil, groundwater, surface water and sediment at select areas of the Site. Despite the development and implementation of the Site-specific RMP, the with the exception of the No Action alternative, each of the remedial alternatives presented herein incorporate the use of an RMP as a corrective measure.

3.0 CORRECTIVE ACTION OBJECTIVES

3.1 Introduction

Media-specific target clean up levels for environmental media have been established for the Site. These target clean-up levels were developed utilizing a risk-based approach, as detailed in the SSRA and summarized below

3.2 Target Clean Up Level

The target clean up levels established for the Site correspond to the media and exposure pathways identified in the SSRA and are as follows:

- Reduce or eliminate direct contact threat to human health and the environment associated with Site-specific environmental media; and
- Protection of human health from ingestion of groundwater at the Site.

The target soil clean up level was developed utilizing a risk-based approach. The risk-based approach utilizes exposure assessment of each identified receptor population and toxicity assessment of chemicals of concern identified in each Site-specific environmental media. In addition, the target clean up level applies to cumulative exposures at the Site (i.e., cumulative exposures resulting from exposure to all environmental media at the Site). It should be noted that this is a conservative clean up goal as it assumes that each identified receptor population at the Site will be exposed to all environmental media simultaneously. For this Site, a theoretical lifetime excess cancer risk (ELCR) of 1×10^{-5} was applied for cancer risk; a non-cancer hazard index (HI) of 1.0 was applied for the HI.

The COCs identified for environmental media at the Site were carried through the SSRA and evaluated for anticipated future receptors on a Site-wide basis. Based on results of this evaluation, in the absence of a permanent remedy and/or land use restrictions implemented through an environmental covenant, the target HI goal of unity (1) and the ELCR goal of 1×10^{-5} is exceeded for:

- Construction/excavation workers for *cumulative* direct contact exposures associated with total soil (0-10 ft bgs), groundwater (where depth to water was encountered from 0 to approximately 11 ft bgs) and sediment (from the unnamed tributary to Tinkers Creek).

As indicated above, the target HI of unity and the ELCR goal of 1×10^{-5} is only exceeded when direct contact exposures by construction/excavation workers are considered on a *cumulative* basis. As depicted in the table below, it should be noted that when rounded to one significant digit, the direct contact

exposure pathway for each individual environmental media quantitatively assessed at the Site meets acceptable hazard and risk goals on an individual basis.

Exposure Pathway	On-Site Construction/Excavation Worker	
	Hazard	**Risk**
Direct Contact with Total Soil[a]	1.2E+00	7.1E-06
Direct Contact with Groundwater[b]	1.2E+00	4.5E-07
Direct Contact with Sediment	7.3E-01	9.6E-06
Total	**3.E+00**	**2.E-05**

a. Total soil includes the 0-10 ft bgs interval

b. Where depth to groundwater is encountered from 0 to approximately 11 ft bgs

As depicted in the table above, the HI for the direct contact with total soil and direct contact with groundwater exposure pathways both exceed the HI of unity on an individual basis, but are equivalent to the HI goal of unity (1) when rounded to one significant digit. The HI and ELCR for the direct contact with sediment exposure pathway are both below their respective hazard and risk goals on an individual basis. Furthermore, as presented in Section 2.3.2, chlorinated compounds observed in groundwater in the northwest portion of the Site and PAHs observed in sediment samples collected immediately beneath the Bedford Anodizing outfall have not been attributed to an on-Site source. Nevertheless, corrective measure alternatives developed herein will focus on addressing potential *cumulative* direct contact exposures.

4.0 IDENTIFICATION, SCREENING AND DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

Remedial alternatives evaluated as part of the CMP must reduce or eliminate unacceptable hazards and/or risks to human health and the environment. Given that hazards and risks are only exceeded for a single receptor population (i.e., construction/excavation workers) and that these exceedances are only observed on a cumulative basis, a limited number of remedial alternatives have been evaluated herein. Furthermore, although groundwater is not currently used for potable purposes, the alternatives also include restricting the use of groundwater beneath the Site for potable purposes.

4.1 Corrective Measure Technologies

Several corrective measure technologies were identified to achieve the corrective measure objectives listed in Section 3.0. The corrective measure technologies fall into three basic categories: No Action, Institutional Controls, and Source Reduction. There are various technologies available to implement these corrective measures, including, but not limited to: Environmental Covenants Restricting Land Use (i.e., institutional controls), and Soil Excavation with off-Site Disposal and In-Situ Treatment of Groundwater (i.e., source reduction). However, not all technology types are appropriate or applicable. Technologies that have been retained for further screening and/or development within this CMP include:

- Environmental covenants;
- Risk Mitigation Plan;
- Excavation/Extraction; and
- In-Situ Treatment.

4.2 Soil Corrective Measure Alternatives

Corrective measure alternatives for soil at the Site retained for further evaluation include the following:

- No action;
- Land use restrictions to limit land use at the Site to commercial/industrial;
- Risk mitigation for workers through health and safety procedures; and
- Soil excavation (hot spot removal), off-Site disposal, and backfill with clean material.

In-situ treatment options were not considered a viable option for on-Site soil. One concentration of arsenic in soil was identified as the major contributor to the HI observed for the direct contact with total soil exposure pathway. Delineation activities have defined the lateral extent of the arsenic-impacted soils and

have identified a very limited area of impact. Therefore, in-situ treatment options were not considered to be technically sound.

4.3 Groundwater Corrective Measure Alternatives

Corrective measure alternatives for groundwater at the Site retained for further evaluation include the following:

- No action;
- Restrictions on use and extraction of groundwater; and
- Risk mitigation for workers through health and safety procedures.

Extraction and in-situ treatment (i.e., source reduction) of groundwater were not considered further as part of this CMP. As indicated above in Section 2.3.2, groundwater impacted with chlorinated compounds in the northwest portion of the Site is not the result of historical or current Ferro operations. Specifically, Ferro's historical and current operations at the Site do not include the use of tetrachloroethene. Rather, it appears that historical operations from the property located adjacent and to the north, Bedford Anodizing, may be the cause of the chlorinated compounds observed in groundwater at this portion of the Site. Please refer to the SSRA for a more comprehensive discussion of the evidence attributing the presence of chlorinated compounds to an off-Site source. Since the chlorinated compounds observed in groundwater at the Site are likely attributable to an off-Site source, they are not subject to the Administrative Consent Order. Therefore, source reduction technologies were not evaluated for the groundwater environmental medium at the Site.

4.4 Sediment and Surface Water Corrective Measure Alternatives

Corrective measure alternatives for sediment and surface water within the unnamed tributary to Tinkers Creek were not evaluated as part of this CMP. As indicated herein, hazards and risks only exceed their respective goals when direct contact exposures by construction/excavation workers are considered on a *cumulative* basis. As presented in the table embedded within Section 3.2, the HI and ELCR attributed to the direct contact with sediment exposure pathway are both below their respective goals (i.e., HI of unity (1) and ELCR of $1x10^{-5}$). As such, the development and screening of corrective measure alternatives was not deemed necessary for sediment (*i.e.*, direct contact with soil and groundwater drive the observed cumulative HI exceedance). Direct contact exposures to surface water were assessed qualitatively rather than quantitatively within the SSRA and were therefore not considered in the cumulative estimation. It should also be noted that the observed presence of select chlorinated compounds in surface water is likely attributed to an off-Site source described above in Section 2.3.2 and PAHs observed in sediment are also likely attributed to an off-Site source as described above in Section 2.3.2. Nevertheless, in order to be

protective of construction/excavation workers, risk mitigation measures for construction/excavation workers will incorporate protective measures for direct contact exposures to surface water and sediment.[1]

4.5 Corrective Action Measures Alternative Development

Technology types were identified in Section 4.1; process options were developed for their implementation. Each process option was evaluated against multiple criteria including effectiveness, implementability, and cost. This qualitative assessment was performed to narrow potential process options for each remedial technology type. The resulting field of preferred process options was used to develop the corrective action measures alternatives.

Some remediation technology alternatives were eliminated from further consideration primarily because of uncertainty with respect to overall effectiveness and implementability. For example, "Zoning Ordinance Restricting Land Use" was eliminated because control over local zoning is not directly influenced by Ferro.

4.6 Corrective Action Measures Alternatives Array

Corrective action measures alternatives were developed by combining various remedial technology options to identify a corrective action measure response that will achieve the corrective action measure objectives. The goal of this approach was to provide a set of remedial alternatives with a breadth of effectiveness, implementability, and costs. The corrective action measures alternatives are presented in Table 1. The three remedial alternatives that were developed (Alternatives A through C) are defined below.

- **Alternative A** – No remedial actions are taken at the Site, including no land use restrictions.
- **Alternative B** – An Environmental Covenant will be established that restricts land use at the Site to commercial/industrial and precludes potable use of groundwater beneath the Site. A Risk Mitigation Plan will also be implemented for construction/excavation workers who may be in direct contact with soil, groundwater, sediment and surface water. Areas of the Site covered by an RMP are depicted on Figure 4.
- **Alternative C** – Removal and off-site disposal of soil at the Site that contributes to cumulative unacceptable direct contact risk goals for construction/excavation workers. Soil samples would be collected from the excavation area immediately following excavation activities and clean backfill will be placed to original grade following excavation activities. An Environmental Covenant will also be established that restricts land use at the Site to commercial/industrial and precludes potable use of

[1] Although surface water exposures were evaluated qualitatively in the SSRA and were not identified as requiring further evaluation, risk mitigation measures will be incorporated for surface water since it is not reasonably anticipated that earthwork activities directly related to sediment can be implemented without first handling the presence of surface water within the unnamed tributary.

groundwater beneath the Site. A Risk Mitigation Plan will also be developed to address *cumulative* direct contact exposures related to groundwater and sediment (*i*.e., following removal of the soil "hotspot"). The area of the Site identified for soil excavation and backfill with clean soil as well as the area requiring an RMP to protect on-Site construction/excavation worker is depicted on Figure 4.

Collectively, these remedial alternatives represent a range of source reduction and institutional control options that effectively address environmental media at the Site that has been impacted by on-Site and off-Site sources. The array of remedial alternatives is further evaluated in Section 5 to support U.S. EPA's selection of the most appropriate remedy for the ultimate end-use of the Site.

5.0 EVALUATION OF CORRECTIVE ACTION MEASURE ALTERNATIVES

5.1 Introduction

An analysis of remedial alternatives was conducted to provide the U.S. EPA with information needed to support selection of a remedy for the Site. Ferro evaluated each of the alternatives that passed initial screening. This analysis consisted of comparing each alternative with the set of evaluation criteria set forth by U.S. EPA, as well as evaluating each alternative's environmental effects, and physical or legal constraints.

The following eight evaluation criteria were used to evaluate the three assembled corrective action measure alternatives (Alternatives A through C). These criteria consisted of the following:

- Long-term Effectiveness;
- Implementability;
- Short-term Effectiveness;
- Reduction of Toxicity, Mobility or Volume;
- Community Acceptance;
- State Acceptance;
- Cost; and
- Overall Protection of Human Health and the Environment.

An evaluation of these criteria for each of the proposed corrective action measure alternatives is provided in Table 2.

5.1.1 Long-Term Effectiveness

Alternatives were assessed for the long-term effectiveness and permanence they can provide, along with the degree of certainty that the alternative will prove successful. Factors considered part of the long-term effectiveness evaluation include:

- The nature and magnitude of total residual risks;
- The type, degree and adequacy of long-term management required for untreated substances and treatment residuals;
- The long-term reliability of engineering and institutional controls, if any, including uncertainties associated with land disposal of untreated hazardous substances, pollutants and contaminants, as well as treatment residuals; and

- The potential need for replacement of the remedy and the continuing need for repairs to maintain remedy performance.

5.1.2 Implementability

The technical and administrative feasibility of implementing the alternatives were assessed by considering the following types of factors, as appropriate:

- Technical Feasibility - including the degree of difficulty and unknowns associated with the construction of a technology, the expected operational reliability of the alternative, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy;

- Administrative Feasibility – including activities needed to coordinate state, local, and federal agencies and to obtain necessary permits or approvals; and

- Feasibility of Obtaining Services and Materials.

5.1.3 Short-term Effectiveness

The short-term impacts of the alternatives were assessed considering the following:

- Short-term risks that may be posed to the community during construction and implementation of an alternative and until the corrective action measure objectives have been met;

- Potential impacts on workers during implementation of remedial activities until corrective measure action objectives have been met and the effectiveness and reliability of protective measures;

- Potential environmental impacts that may result from the remedial action and the effectiveness and reliability of mitigative measures during implementation and until the objectives of the corrective measure actions have been met; and,

- Time until corrective measure action objectives are achieved.

5.1.4 Reduction of Toxicity, Mobility or Volume

The degree to which alternatives employ treatment that reduces toxicity, mobility or volume of contaminants was assessed. Factors that were considered included the following:

- The treatment or recycling processes the alternatives employ and materials they will treat;

- The amount of hazardous substances, pollutants or contaminants that will be destroyed, treated or recycled;

- The degree of expected reduction in toxicity, mobility or volume of the waste due to treatment or recycling and the specifications of which reduction(s) are occurring;

- The degree to which the treatment is irreversible;

- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility and propensity to bioaccumulate;
- The degree to which treatment will reduce the inherent hazards posed by the principal threats at the Site; and
- The degree to which the treatment processes employed reduce the transfer of contaminants between environmental media.

5.1.5 Community Acceptance

The assessment of alternatives includes evaluating which components of the alternatives that interested persons in the community would be likely to support, have reservations about, or oppose. This is evaluated as part of the public hearing/public comment period following issuance of the Agency's preferred plan for the Site.

5.1.6 State/Agency Acceptance

State or Agency acceptance is evaluated after the Agency receives public comments on the preferred alternative and prior to the Agency's selection of the final remedy for the Site.

5.1.7 Cost

The types of costs that were considered include the following:

- Direct and indirect capital costs, including contingency and engineering fees;
- Annual operation and maintenance costs;
- Periodic costs associated with predicted one-time capital expenditures occurring after the first stage of implementation; and
- Net present value of capital and operation and maintenance costs.

The Cost Analyses for Alternative B and C are provided in Appendix A. Alternative A is the No Action alternative and thus has no costs associated with it.

5.1.8 Overall Protection of Human Health and the Environment

Alternatives were assessed with regard to their ability to protect human health and the environment from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the Site by eliminating, reducing or controlling exposures to established risk and hazard goals.

5.2 Detailed Description of Alternatives

5.2.1 Corrective Action Measure Alternative A

Alternative A consists of taking no action. Under the No Action alternative, no remedial action will be taken to remove, control, mitigate or minimize exposure to contaminated environmental media. The No Action alternative establishes a baseline or reference point against which each of the corrective action measure alternatives are compared. In the event that the other identified alternatives do not offer substantial benefits in the reduction of toxicity, mobility, or volume of the constituents of concern, the No Action alternative may be considered a feasible approach.

Under Alternative A, no effort would be made to control the future use of the Site. The present worth cost and capital cost of Alternative A are $0, because no costs will be incurred by taking no action.

The No Action alternative was not selected for the Site because it is not protective of human health. Specifically, although groundwater at the Site is not currently used for potable purposes, the No Action alternative does not include a restriction against potential future potable use of groundwater beneath the Site. In addition, the No Action alternative is not protective of human health since a land use restriction is necessary to preclude residential land use at the Site. Therefore, the No Action alternative does not meet the threshold criterion.

5.2.2 Corrective Action Measure Alternative B

Alternative B relies on institutional controls to restrict land use as well as an RMP to protect construction/excavation workers from cumulative direct contact exposures to soil, groundwater, and sediment. The institutional controls specifically include an environmental covenant that (1) would restrict land use at the Site to commercial/industrial; and (2) would restrict groundwater beneath the Site from potable use.

While Alternative B does not provide any active or engineered reduction in the toxicity or volume of contaminated soil through treatment and long-term risks have been identified (*i.e.,* an RMP is a necessary component of this alternative), the benefits gained from this alternative outweigh the low source reduction score presented in Table 3, which is directly attributed to the challenging location and limited volume of material that would be the subject of removal efforts. In addition, this alternative can be readily implemented.

The present worth cost and capital cost of Alternative B is approximately $11,550. Capital costs include preparation and filing of an environmental covenant for the Site and revisions/updates of the existing Risk Mitigation Plan. These costs are described in Table A-1 in Appendix A.

5.2.3 Corrective Action Measure Alternative C

Alternative C is an active remedy that would remove the arsenic impacted soil at the Site. Based upon baseline and delineation soil analytical data collected at the Site, it is assumed that approximately 105 cubic yards of soil would be excavated and transported off-Site for disposal. Confirmation samples would be collected at the bottom of the excavation prior to backfilling to grade with clean soil. Alternative C includes the following components:

- Covenants on land and groundwater use;
- Risk Mitigation Plan;
- Removal and off-site disposal of impacted soil;
- Excavation confirmation sampling; and
- Backfill with clean soil.

Alternative C would entail excavation, loading, transportation and disposal of approximately 105 cubic yards (cy) of excavated material and subsequent import of approximately 105 cy of clean soil backfill. Alternative C removes future uncertainty with respect to whether or not direct contact exposure to the single elevated arsenic concentration will occur by on-Site Construction/Excavation Workers.

Removal of arsenic-impacted soil at the Site is permanent and effective in the long-term. Done properly, it will result in reduced (eliminated) volume of contaminants (although the volume requiring excavation under this alternative is relatively small), and long-term protectiveness of human health and the environment, albeit at a higher cost than other alternatives and with short-term risks due to excavation, transportation, and disposal.

Implementation of this alternative, however, would be challenging. The arsenic-impacted soil area is bound to the east by the Polyamine Building, to the south by an overhead pipeline, and is currently beneath a concrete paved driveway. These physical constraints would require additional considerations during active soil excavation activities. However, due to the physical constraints combined with the arsenic delineation sampling, a limited volume of soil would require removal, resulting in limited short-term impacts during the removal and backfill activities. These short-term impacts, including but not limited to, fugitive dust and stormwater run-off controls, potential structural/operational damages during implementation, traffic impacts during excavation and off-Site transport, could be controlled through contingency planning measures. Off-site transportation and disposal liability risks exist. There are no identified on-site long-term risks or maintenance concerns with this alternative, other than the potential liability at the off-site disposal location.

As indicated, higher costs are associated with this alternative due to the excavation activities. Although this alternative results in a volume reduction of arsenic-impacted soil, the arsenic-impacted soil is located below the applicable point of compliance (0-2 ft bgs) for a commercial/industrial worker. Therefore, active soil remedial activities included in this alternative only address direct contact exposures to construction/excavation workers, who are only assumed to work on-Site for one-year duration. In addition, construction/excavation workers could work anywhere at the Site; this implies that construction/excavation workers may not encounter the single elevated concentration of arsenic observed at depth during intrusive earthwork activities.

Despite the excavation activities included as part of Alternative C, this alternative still relies upon the implementation of an RMP in order to mitigate cumulative direct contact exposures resulting from direct contact exposures to groundwater and sediment (as well as surface water). As indicated above in Section 2.3.2, the chlorinated compounds observed in groundwater in the vicinity of monitoring well HMW-3 and the PAHs observed in sediment directly beneath the storm water outfall within the unnamed tributary to Tinkers Creek are believed to originate from an off-Site source. As a result, active remedial activities to address these observed contaminants in groundwater and sediment have not been proposed herein. Therefore, despite the removal of the very limited arsenic-impacted soils observed at the Site, this alternative still requires the implementation of an RMP in order to mitigate *cumulative* direct contact exposures posed to construction/excavation workers.

The total cost of Alternative C is approximately $75,400 assuming removal of the single location of arsenic-impacted soil at the Site. These capital costs include the Environmental Covenant, Risk Mitigation Plan, excavation, waste management and disposal, backfill and confirmatory sampling.

5.3 Comparative Analysis of Alternatives

Table 3 provides a qualitative comparison of the remedial alternatives for the Site. A relative scoring of 1 to 10 was assigned to each of the eight evaluation criteria. Those remedial alternatives that meet the criteria, or are predictably more cost-effective and practical, receive a higher score than those that do not. The following subsections provide a more detailed description of the evaluation process.

5.3.1 Comparison Based on Eight Evaluation Criteria

Alternative A, the No Action alternative, does not meet the Overall Protectiveness of Human Health and the Environment threshold criteria and is therefore not evaluated further.

Alternative B, the environmental covenants and RMP implementation, meets the threshold criteria for Overall Protectiveness of Human Health and the Environment since the covenants and the RMP will mitigate

risks to human receptor populations. This alternative receives the highest score in the scoring matrix since it is relatively easy to implement, mobilization of contaminants is precluded since no excavations are proposed, and is cost-effective.

Alternative C includes active remediation *via* excavation of arsenic-impacted soil, off-Site disposal and backfill with clean soil to eliminate unacceptable risks to the construction/excavation worker. However, this alternative still relies upon an RMP to protect the construction/excavation worker from cumulative direct contact exposures to groundwater and sediment (as well as surface water). In addition, this alternative includes the removal of a very limited volume of material (i.e., 610 cubic yards) that is currently below the 0-2 foot point of compliance for a commercial/industrial worker. Thus, removal activities are only applicable to on-Site Construction/Excavation Workers, who may not even come into direct contact with the limited area associated with the arsenic-impacted soils. As a result, this alternative reduces future uncertainty with respect to whether soil direct contact exposures to arsenic in soil by on-Site Construction/Excavation Workers will occur; although there would be a gain in the reduction of risk via removal activities, the risk may alternatively be mitigated through implementation of an RMP.

As indicated in Section 4.4, active remedial alternatives were not evaluated for groundwater and sediment since the observed contaminants (i.e., chlorinated compounds and PAHs) cannot be attributed to an on-Site source. Thus, Alternative C receives a lower score than Alternative B since substantial planning is required to implement the excavation area (i.e., physical constraints), and short-term effectiveness scores low since excavated material will be transported off-Site. Furthermore, although this alternative includes excavation of arsenic-impacted material, the long-term effectiveness cannot be scored any higher due to sediment and groundwater impacts likely originating from off-Site sources.

5.3.2 Environmental Impact of Alternatives

Environmental impacts of the remedial alternatives are also considered when selecting a remedy. This assessment includes consideration of measures to prevent and mitigate adverse environmental impacts.

The majority of the Site is developed for industrial purposes and contains no significant ecological receptors or habitat. However, the northwest portion of the Site includes the unnamed tributary to Tinkers Creek; the aquatic life habitat designation for this portion of the creek is identified as a Limited Resource Water (LRW).[2] As such, attainment of water quality standards with respect to aquatic life within this tributary is not expected or anticipated based upon its location and corresponding water quality designation.

None of the alternatives evaluated herein include active remedial activities to address ecological receptor populations in this area. Elevated levels of PAHs observed in sediment samples collected immediately beneath the storm water discharge outfall pipe originating from Bedford Anodizing's property are not attributed to an on-Site source. In addition, the observed presence of chlorinated compounds in surface water, including vinyl chloride, are likely daughter products resulting from the breakdown of tetrachloroethene in HMW-3 groundwater. Pursuant to the ACO, a source area originating on or emanating from the Site that consists of chlorinated compounds or PAHs has not been identified at the Site. Therefore, active remedial activities have not been evaluated as part of this CMP for ecological receptor populations.

[2] In accordance with OAC 3745-1-07(B)(1)(g), LRWs are defined as "waters that have been the subject of a use attainability analysis and have been found to lack the potential for any resemblance of any other aquatic life habitat. The use attainability analysis must demonstrate that the extant fauna is substantially degraded and that the potential for recovery of the fauna to the level characteristic of any other aquatic life habitat is realistically precluded due to natural background conditions or irretrievable human-induced conditions."

6.0 RECOMMENDATION OF CORRECTIVE ACTION MEASURE

This document provides the basis for U.S. EPA's selection of a remedial alternative that is reasonable and feasible for the Site, and the subsequent preparation of a decision document.

Based upon the analysis presented herein, it is recommended that **Alternative B** would be identified as the most reasonable and remedial alternative. This alternative is protective of human health by use of an Environmental Covenant to (1) restrict land use at the Site to commercial/industrial land use, and (2) precludes potable use of groundwater at the Site; and is protective of construction workers by use of a Risk Mitigation Plan to mitigate *cumulative* direct contact exposures to environmental media at the Site.

7.0 PUBLIC INVOLVEMENT PLAN

Concurrent with U.S. EPA submittal of this CMP, one hardcopy of the document herein will be submitted to the public repository for public review. The public will be provided with an opportunity to comment on the CMP during the public comment period. Specifically, U.S. EPA will issue a public statement (*i.e.*, Statement of Basis) outlining U.S. EPA's preferred alternative along with a timeframe for the public comment period. During this time, the public can submit their comments and/or questions regarding the preferred alternative. The U.S. EPA will select the final alternative utilizing the information presented herein as well as comments received during the public comment period.

8.0 PROPOSED SCHEDULE

Alternative B includes the filing of environmental covenants and implementation of a Risk Mitigation Plan to protect construction/excavation workers from cumulative direct contact exposures to soil, groundwater, and sediment at the Site. An RMP detailing protective measures for mitigating direct contact exposures to soil, groundwater, sediment and surface water by construction/excavation workers working at the Site has been implemented; a hardcopy of the RMP is being submitted to U.S. EPA concurrently with this CMP under separate cover. Therefore, assuming Alternative B is selected, the environmental covenant will be prepared within 60 days of U.S. EPA issuance of the Final Decision and Response to Comments.

9.0 BIBLIOGRAPHY

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TABLES

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE 1

REMEDIAL ALTERNATIVES DEVELOPMENT FLOW CHART

MEDIA	REMEDIAL ACTION OBJECTIVE	REMEDIAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS BY TECHNOLOGY	PREFERRED PROCESS OPTIONS	REMEDIAL ALTERNATIVES
		No Action				**ALTERNATIVE A** No Action
SOIL	Mitigate Risk of Direct Contact with Soil	Institutional Control/Environmental Covenant	Local Ordinance	Zoning Ordinance Restricting Land Use	Covenants on Land and Groundwater Use	**ALTERNATIVE B** Covenants on Land and Groundwater use
			Land Use Restrictions	Covenants on Land and Groundwater Use	Risk Mitigation Plan	Risk Mitigation Plan
			Risk Mitigation Plan	Risk Mitigation Plan		
		Source Reduction	Soil Excavation with Off-Site Disposal and Backfill with Clean Soil	Soil Excavation with Off-Site Disposal and Backfill with Clean Soil	Soil Excavation with Off-Site Disposal and Backfill with Clean Soil	**ALTERNATIVE C** Covenants on Land and Groundwater Use Risk Mitigation Plan Soil Excavation with Off-Site Disposal and Backfill with Clean Soil

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE 2

INDIVIDUAL EVALUATION OF REMEDIAL ALTERNATIVES

CRITERIA	ALTERNATIVE A NO ACTION	ALTERNATIVE B ENVIRONMENTAL COVENANTS Covenants on Land and Groundwater Use Risk Mitigation Plan	ALTERNATIVE C SOIL REMOVAL Covenants on Land and Groundwater Use Risk Mitigation Plan Soil excavation to a minimum depth of 4.5 ft below grade, off-Site disposal and clean soil backfill
LONG-TERM EFFECTIVENESS			
Soil Direct Contact	Source has not been removed. Existing risk will remain.	Source will not be removed, but risks are mitigated through an RMP.	Excavation and backfill with clean soil will eliminate long-term risks.
Groundwater Direct Contact	Contamination has not been removed. Existing risk will remain.	Contamination will not be removed, but risks are mitigated through an RMP.	Contamination will not be removed, but risks are mitigated through an RMP.
Sediment Direct Contact	Contamination has not been removed. Existing risk will remain.	Contamination will not be removed, but risks are mitigated through an RMP.	Contamination will not be removed, but risks are mitigated through an RMP.
Adequacy & Reliability of Controls	No control over remaining contamination. No reliability in the long term.	Relies upon long-term implementation of controls.	Soil removal action will eliminate long-term risk. Relies on long-term implementation of controls.
IMPLEMENTABILITY			
Ability to Construct and Operate	Not applicable.	Environmental covenant can be filed at the county Recorder's office relatively easily.	Removal action concept is relatively simple, but physical contraints must be considered. Would also require transport and handling of approximately 105 cy of soil for off-site disposal and import of 105 cy of clean soil backfill.
Ease of Doing More Action if Needed	Not applicable.	Additional action not anticipated following filing of the environmental covenant and implementation of the RMP.	Additional active remediation action not anticipated following completion of removal and backfill effort.
Ability to Monitor Effectiveness	No monitoring.	Not applicable.	Confirmation sampling will be completed after excavation activities, prior to import of clean fill material.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable.	No approvals needed nor involvement with other agencies.	No approvals needed nor involvement with other agencies.
Availability of Services and Capacities	Not applicable.	Not applicable.	Specialty environmental contractors are available to complete removal action. Excavated fill is anticipated to be disposed of at an off-Site landfill.
Availability of Equipment, Specialists and	Not applicable.	Not applicable.	Equipment is available.
SHORT-TERM EFFECTIVENESS			
Community Protection	Risk to community not increased.	Risk to community not increased.	Risk to community increases significantly due to fill exposure and off-site transportation.

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE 2

INDIVIDUAL EVALUATION OF REMEDIAL ALTERNATIVES

CRITERIA	ALTERNATIVE A NO ACTION	ALTERNATIVE B ENVIRONMENTAL COVENANTS Covenants on Land and Groundwater Use Risk Mitigation Plan	ALTERNATIVE C SOIL REMOVAL Covenants on Land and Groundwater Use Risk Mitigation Plan Soil excavation to a minimum depth of 4.5 ft below grade, off-Site disposal and clean soil backfill
Worker Protection	On-Site construction/excavation workers do not meet acceptable hazard and risk goals due to cumulative direct contact exposures.	Unacceptable hazards and risks mitigated for on-Site construction/excavation workers through RMP.	Despite soil excavation activities, unacceptable hazards and risks remain due to cumulative effects. Risks mitigated for construction/excavation workers through RMP.
Environmental Impacts	Impact equivalent to existing conditions.	Impact equivalent to existing conditions.	Potential stormwater and exposure impacts during soil removal and backfill activities.
Time Until Action is Complete	Not applicable.	Approximately 60 days.	Fill removal and backfill is anticipated within 6 months.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT			
Treatment Process Used	None.	None.	None.
Amount Destroyed or Treated	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.
Reduction of Toxicity, Mobility or Volume	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.
Irreversible Treatment	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.
Type and Quantity of Residuals	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.	Not applicable - no treatment proposed.
Statutory Preference for Treatment	Does not satisfy.	COCs not amenable to treatment.	COCs not amenable to treatment.
COST			
Capital Cost Estimates[a]	$0	$11,550	#REF!
OVERALL PROTECTIVENESS			
Human Health Protection			
Soil Direct Contact	Does not meet protectiveness criteria for commercial/industrial workers and potential future residential land use scenario.	Meets protectiveness criteria.	Meets protectiveness criteria.
Groundwater Direct Contact	Groundwater is not utilized for potable purposes on-Site.	Groundwater is not utilized for potable purposes on-Site.	Groundwater is not utilized for potable purposes on-Site.
Sediment Direct Contact	Meets protectiveness criteria when considered individually.	Meets protectiveness criteria when considered individually.	Meets protectiveness criteria when considered individually.
Environmental Protection	No reduction in risk; ecological receptors evaluated qualitatively.	No reduction in risk; ecological receptors evaluated qualitatively.	No reduction in risk; ecological receptors evaluated qualitatively.

Notes:

a. Refer to Tables A-1 and A-2 in Appendix A for a more detailed breakdown of cost.

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE 3

COMPARISON OF REMEDIAL ALTERNATIVES TO EVALUATION CRITERIA

POTENTIAL REMEDIAL ALTERNATIVE	SCREENING CRITERIA								
	LONG-TERM EFFECTIVENESS	IMPLEMENTABILITY	SHORT-TERM EFFECTIVENESS	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME	COMMUNITY ACCEPTANCE [a]	STATE/AGENCY ACCEPTANCE [b]	COST	OVERALL PROTECTIVENESS OF HUMAN HEALTH AND THE ENVIRONMENT	OVERALL REMEDY SCORE
Alternative A	1	10	10	1	[a]	[b]	10	5	37
No Action									
Alternative B	5	10	10	1	[a]	[b]	10	10	46
Environmental Covenant									
Risk Mitigation Plan									
Alternative C	5	5	1	5	[a]	[b]	10	10	36
Environmental Covenant									
Risk Mitigation Plan									
Excavation of impacted soil to minimum depth 4.5 feet below grade									
Off-Site Disposal									
Confirmatory Sampling									
Backfilling									

Long Term Effectiveness

10 - Effective strategy that does not rely on RMP to maintain effectiveness.

5 - Acceptable remedial strategy, but relies on RMP to maintain long-term remedy performance.

1 - Remedy not protective of human health or environment in the long term.

Implementablility:

10 - Remedy easily implemented, effective, and requires very few or no permits.

5 - Remedy may be perceived as little to no action completed and will require logistical and permit complications.

1 - No technology exists or existing technology is very difficult to implement based on permitting or logistics.

Short-term Effectiveness

10 - Little or no mobilization of contaminants or exposure of impacted materials to the environment or humans.

5 - Some mobilization and exposure to impacted material; effects limited mainly to on-site.

1 - Significant mobilization and exposure to impacted material; effects felt community-wide.

Reduction of Toxicity, Mobility, or Volume

10 - Impacted materials are removed from site.

5 - A portion of impacted materials are removed from the site, or all or some of the materials are managed on-site with no removal.

1 - All or most of the impacted materials are managed on-site.

Community Acceptance

[a] Community Acceptance is evaluated as part of the public hearing/public comment period following issuance of the Agency's preferred plan for the Site, and so is excluded from scoring within the matrix above.

State Acceptance

[b] State/Agency Acceptance is evaluated after public comments are received on the preferred plan and prior to the Agency's selection of a final remedy for the Site, and so is excluded from scoring within the matrix above.

Costs:

10 - < $1,000,000

5 - $1,000,000 - $5,000,000

1 - > $ 5,000,000

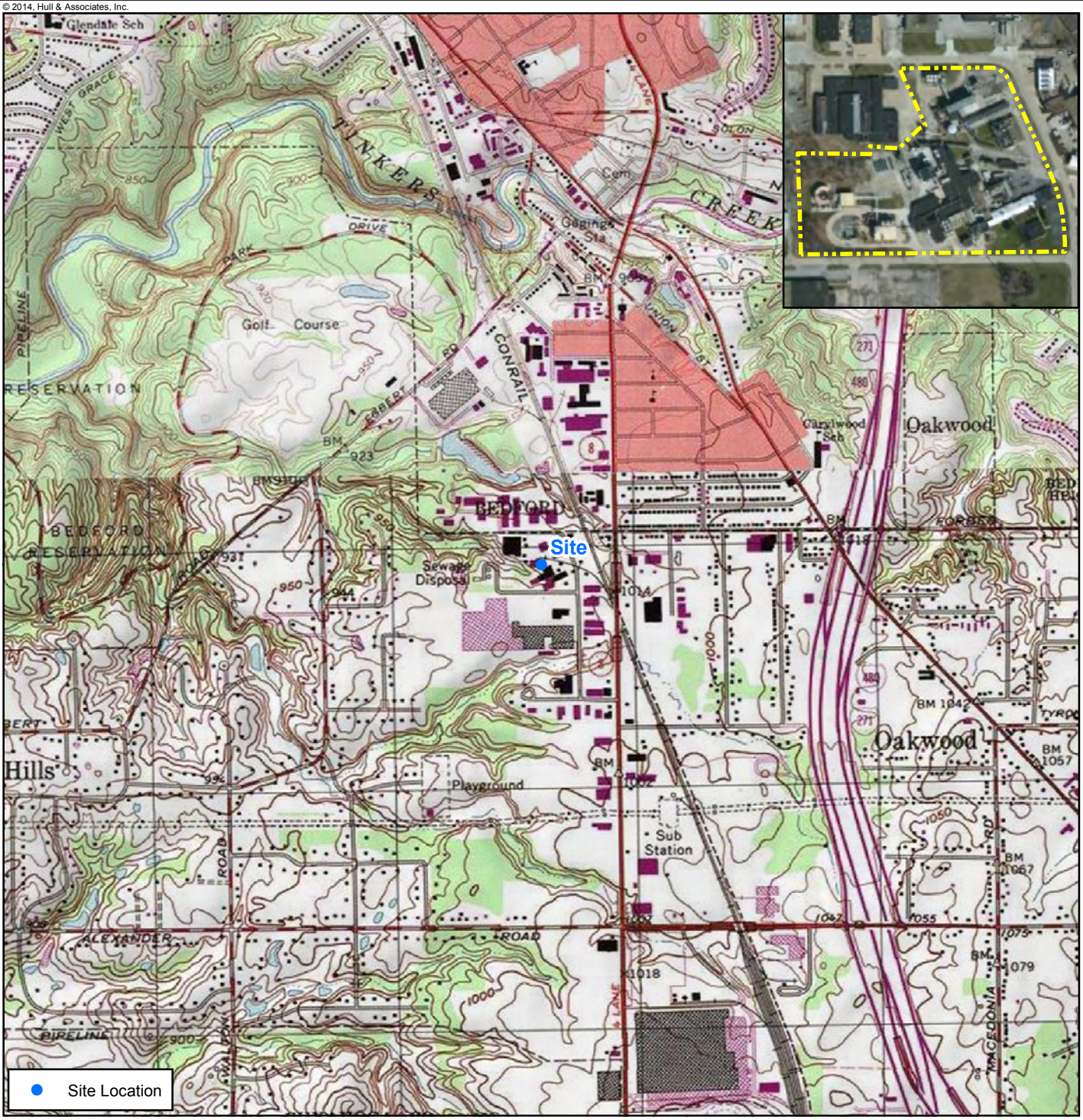
Overall Protectiveness of Human Health and the Environment

10 - No adverse impact to human health or the environment.

5 - Adverse impact to human health and the environment in the impacted area.

1 - Adverse impact to human health and the environment in both the impacted and non-impacted areas.

FIGURES



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0 500 1,000 2,000 Feet

1:24,000

Quad: Northfield

Source: The topographic map was acquired through the USGS Topographic Map web service.

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Site Location Map

7050 Krick Rd
Walton Hills, Cuyahoga County, Ohio

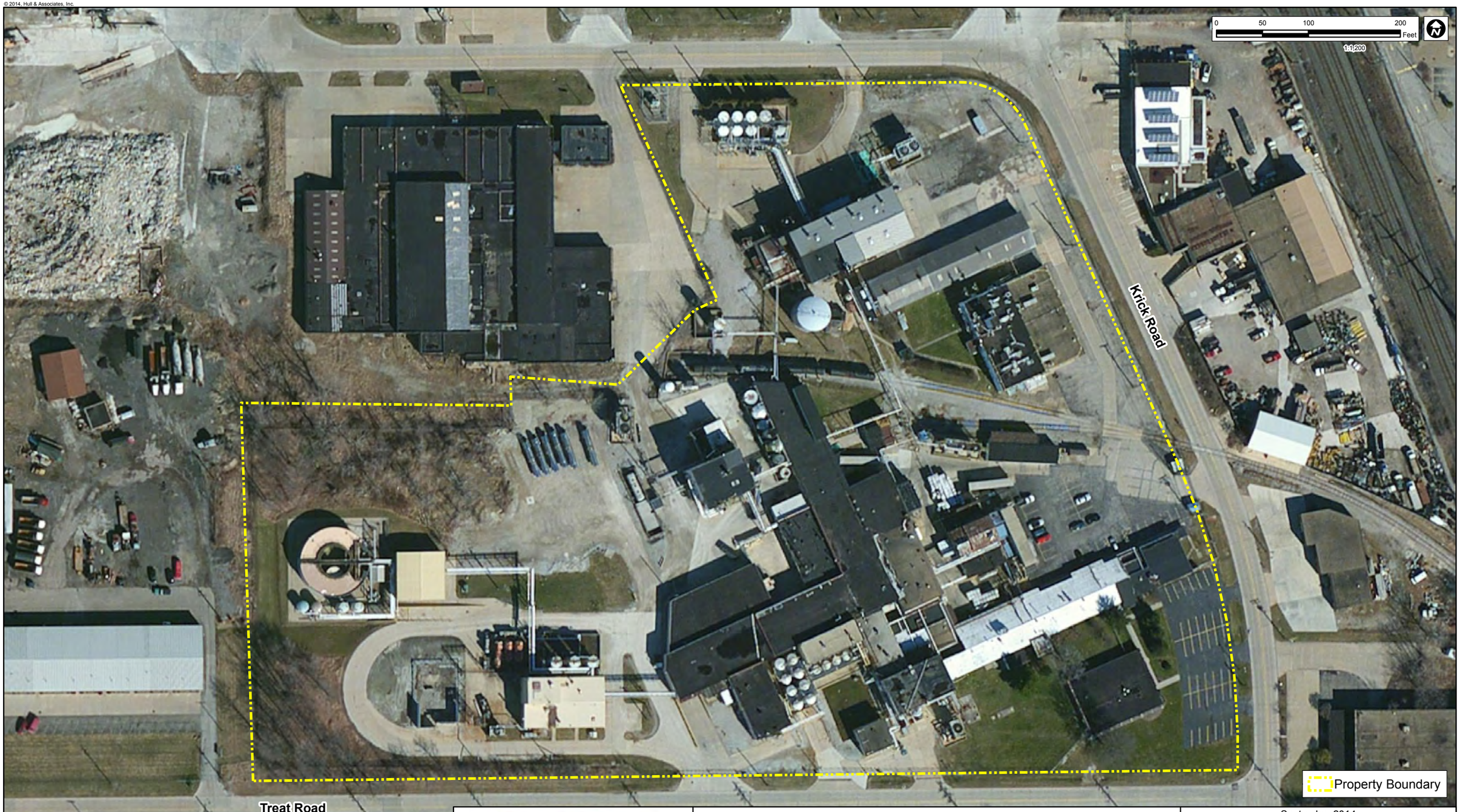
Date:
September 2014

File Name:
FCO028_12_Fig01_SLM.mxd

Edited: 9/11/2014 By: jslifer

Figure
1

Produced using ArcGIS 10.0 SP1



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Corrective Measures Proposal
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Site Layout

7050 Krick Rd
Walton Hills, Cuyahoga County, Ohio

Figure 2

Produced using ArcGIS 10.0 SP1
File Name: FCO028_12_Fig02_SiteLayout.mxd
Edited: 9/11/2014 By: jslifer

0 37.5 75 150 Feet

1:1,800

SWMU #	Description
1	Drum Storage Pad
2	Satellite Accumulation Areas
2A	High Pressure Area
2B	Liquids Manufacturing
2C	Pow ders Building
3	R & D Container Storage Area
4	Drum Storage in the Boiler Room
5	Cadmium Dust Collection Unit
6	Waste Oil Storage Area
7	Epoxy Wastew ater Pretreatment Facility
8	Wastew ater Treatment Facility
9	Sludge Bin Roll Aw ay Container
10	Polyamine Building Construction Area
11	Buried Drum Removal Area
12	North Tank Farm
13	West Tank Farm
14	In-fill area (Low er Parking lot) - oil/w ater separater
15	Site Wide Groundw ater
16	Fine Organics 90 day storage
17	90 Day Bulk Storage
18	Trash Compactor
19	Epoxy Press Cake Hopper
20	Biotreatment plant
21	Former Northern Hazardous Waste Storage
22	Underground Acid and Waste Tanks
23	Less than 90-day hazardous w aste storage
24	Boiler room tank farm

AOC #	Description
1	Xylene Spill
2	Solvent USTs

Krick Rd.

Treat Rd.

Project Boundaries
Parcel Boundaries
SWMUs
AOCs
Further Assessment Required
No Further Assessment Required

Notes:
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Site Map with SWMUs and AOCs

7050 Krick Road
Walton Hills, Cuyahoga County, Ohio

Figure 3

Produced using ArcGIS 10.0 SP1
File Name: FCO028_12_Fig03_SWMUsAOCs.mxd
Edited: 9/10/2014 By: jslifer

Risk Management Area A – This area reflects the portion of the Site that requires risk mitigation measures for direct contact exposures to groundwater and sediment by on-Site construction/excavation workers. This area would be applicable under both Alternative B and Alternative C.

Risk Management Area B – This area reflects the portion of the Site where arsenic in soil contributes to a cumulative exceedance of acceptable direct contact hazard and risk goals by on-Site construction/excavation workers. Under Alternative B, this area would require implementation of a Risk Mitigation Plan to protect the on-Site construction/excavation worker from direct contact exposures to arsenic in soil. Under Alternative C, this area would require excavation of arsenic-impacted soil to a depth of approximately 4.5 ft bgs and backfill with clean material.

0 50 100 200 Feet

1:1,200

HMW-6, SB21-3, SB21-6, SB21-2, SB21-1, SB21-5, SB21-4, SBa2-3, SBa2-2, SBa2-1, HVP-7, HMW-7, HVP-6, SB3-1, SB3-4, SB3-3, SB3-2, HMW-8, SB7-3, SB7-1, HMW-4, SB7-4, SB7-2, SB-3/3A, HVP-1, HMW-13, HMW-12, SW-5, SD-2, SW-4, SW-3, SD-1, HMW-3, SB14-6, HVP-2, SB14-2, SB14-4, SB14-3, SB14-8, SB14-7, HMW-11, SB14-1, SW-2, HMW-2, SB22-3, HMW-5, SB22-2, HVP-5, SB24-1, SB24-2, HVP-3, SB24-3, SB14-5, HMW-10, SW-1, SB11-5, HMW-9, SB11-4, SB11-1, SB11-3, SB11-2, SBa1-2, SBa1-1, HVP-4, SBa1-3, HMW-1

- Property Boundary
- Monitoring Well
- Sample Point
- Sediment Sample
- Soil Boring
- Vapor Probe
- Risk Management Area A
- Risk Management Area B

Notes:
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Summary of Risk Management Areas

7050 Krick Rd
Walton Hills, Cuyahoga County, Ohio

Figure 4

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File Name: FCO028_12_Fig04_RiskMgmtAreas.mxd

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APPENDIX A

Cost Analyses for Remedial Alternatives

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE A-1

COST ANALYSIS FOR REMEDIAL ALTERNATIVE B
ENVIRONMENTAL COVENANT

This component includes the development and filing of an environmental covenant to restrict land use to commercial/industrial and preclude potable use of groundwater as well as development and implementation of an RMP.

DESCRIPTION OF WORK	UNIT PRICE	ESTIMATED QUANTITY		ESTIMATED TOTAL
Task 1 - EC and RMP				
Environmental Covenant	8,000	1 ls		$8,000
Risk Mitigation Plan[a]	2,500	1 ls		$2,500
Project Management (10%)	1,050	1 ls		$1,050
			Sub-Total	**$11,550**
	CAPITAL COST ESTIMATE			**$11,550**
	-30/+50% COST RANGE		**$8,000 -**	**$17,000**

a. A Risk Mitigation Plan was developed and implemented as part of Interim Corrective Measures. The costs included herein reflect contingency costs in the event RMP revisions or updates are required.

CORRECTIVE MEASURES PROPOSAL
FERRO CORPORATION
7050 KRICK ROAD, WALTON HILLS, OHIO

TABLE A-2

COST ANALYSIS FOR REMEDIAL ALTERNATIVE C
EXCAVATION

This component includes excavation and off-site disposal of approximately 105 cubic yards of arsenic-impacted soil, as well as development of an environmental covenant and implementation of a Risk Mitigation Plan.

DESCRIPTION OF WORK	UNIT PRICE	ESTIMATED QUANTITY	ESTIMATED TOTAL
Task 1 - EC and RMP			
Environmental Covenant	$ 8,000 /ls	1 ls	$ 8,000
Risk Mitigation Plan[a]	$ 2,500 /ls	1 ls	$ 2,500
Project Management (10%)	$ 1,050 /ls	1 ls	$ 1,050
		Sub-Total	**$ 11,550**
Task 2 - Site Remediation of Area B [b]			
H&S Plan, Mobilization, Demobilization, and General Conditions Complete (15% of total hard cost amount)	$ 4,082 /ls	1 ls	$ 4,082
Demolition and Disposal of Existing Concrete Pavement Complete	$ 12 /sf	610 sf	$ 7,320
Excavate and Loading of Non-Hazardous Soils Complete	$ 25 /yds	105 yds	$ 2,625
Off-site Non-Hazardous Soils Transportation and Disposal Complete	$ 55 /ton	168 tons	$ 9,240
Import, Backfilling, and Compaction of Clean HardFill Material Complete	$ 30 /yds	105 yds	$ 3,150
Re-install Concrete Pavement (assumes 6" thick) Complete	$ 8 /sf	610 sf	$ 4,880
Contingency on Construction (15%)	$ 4,695 /ls	1 ls	$ 4,695
Confirmation Sampling (Lab Cost)	$ 1,000 /ls	1 ls	$ 1,000
		Sub-Total	**$ 36,992**
Task 3 - Professional/Technical Services			
Project Management (8%)	$ 3,900 /ls	1 ls	$ 3,900
Remedial Design (15%)	$ 7,300 /ls	1 ls	$ 7,300
Project Oversight/Confirmatory Sampling (Labor)	$ 6,000 /ls	1 ls	$ 6,000
Construction Management (10%)	$ 4,900 /ls	1 ls	$ 4,900
Contingency on Engineering/Design (10%)	$ 4,800 /ls	1 ls	$ 4,800
		Sub-Total	**$ 26,900**
		CAPITAL COST ESTIMATE	**$ 75,442**
	-30/+50% COST RANGE	***$53,000 -***	***$ 113,000***

Notes:

a. A Risk Mitigation Plan was developed and implemented as part of Interim Corrective Measures. The costs included herein reflect contingency costs in the event RMP revisions or updates are required.

b. Proposed area of excavation was determined based on assessment of commercial/industrial hazards and risks. Area estimated at approximately 610 square feet by approximately 4.5 feet deep (105 cy).

Additional Notes:

1. Soils assumed to be Non-Hazardous. Assumes remediation area to be 610 square feet, excavated down to 4.5 feet in depth.
2. Imported soil to be clean hard fill (i.e. crushed limestone aggregate such as ODOT type #304 of #57)
3. Costs based on preliminary quotes from vendors, engineering estimates, and professional experience.
4. These are preliminary estimates that in some cases can be greatly refined with additional data collection and a detailed bid document process. These estimates have been prepared for discussion and planning purposes.
5. Conversion factor of 1.6 was utilized for determining approximate tonnage.